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(54) **Method and system for mastering and distributing enhanced color space content**

(57) A method and system for mastering and distributing enhanced color space content for different display devices (target color space) having display capabilities beyond that of CRT color space. The content creator(s) establishes base or reference color space and enhanced color space data for each target color space. The enhanced color space data is stored as metadata and transmitted over an enhanced color channel separately from the base/reference color space. Both the base/reference data and metadata are encoded before transmission and

decoded on the consumer side either by a separate decoder or a display device having an integrated decoder. In other aspects of the invention, auxiliary data relating to the target color space, such as, for example, brightness, luminance, contrast and other display settings can be transmitted over the enhanced color channel and decoded to control the target color space settings (i.e., display settings). The color adjustment metadata could be included in the auxiliary data or maintained separate from the same depending on the desired implementation.

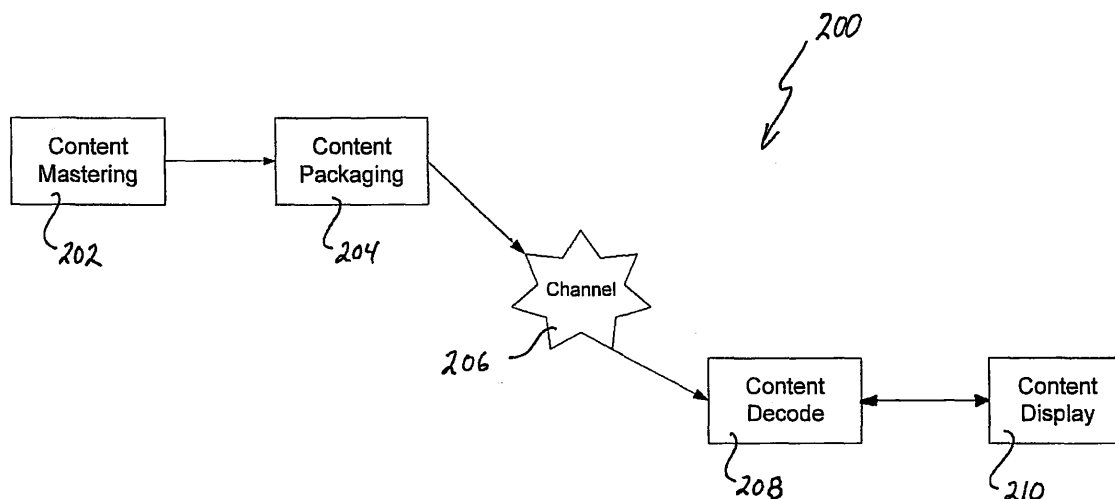


FIG. 2

Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional patent application Serial No 60/623,882 filed on November 1, 2004, which is incorporated herein by reference.

BACKGROUND ART

1. Field of the Invention

[0002] The present invention relates to content creation and delivery. More particularly, the present invention relates to a method and system for enhancing content creation and delivery for use with new emerging display technologies not based on CRT.

2. Description of the prior art

[0003] With today's current technology, it is difficult, if not impossible to re-create a content creator's artistic intent (i.e., with respect to color) on a video display device, especially a video display device for home use. Generally speaking, the only place where such re-creation is possible is in the theater on either film or digital cinema. This "content creator's artistic intent" with respect to color is referred to herein as the "color space" of the content.

[0004] The color space for consumer use has been always targeted for traditional Cathode Ray Tube (CRT) display devices. The idea of extending the color space for different display devices has been the subject of research and publication. Several companies have proposed methods for enhancing the color gamut and/or dynamic range on their display devices, but to date, no known end- to-end system provides backwards compatibility.

[0005] New display technologies are under development and are entering the consumer marketplace. Such new display technologies offer greater picture reproduction capabilities than traditional CRT-based displays. However, present-day video content mastering processes, delivery systems, coding systems and signaling are based solely on CRT.

[0006] As new display technologies with High Dynamic Range (HDR), Enhanced Color Gamut (ECG), and other features enter the consumer marketplace, it becomes necessary to establish a new content production chain that can maximize the potential of these display technologies. Examples of these types of new display technologies include, but are not limited to, Liquid Crystal Displays (LCD), Liquid Crystal on Silicon (LCOS), Plasma Display Panel (PDP), Organic Light Emitting Diode (OLED), High Dynamic Range (HDR) and Enhanced Color Gamut (ECG) display devices.

[0007] Figure 1 shows the color space relationship 100 in today's post production processes. In this example,

three separate color adjustments (106, 108, 110) are performed (i.e., one for film 106, one for digital cinema 108, and one for video 110). The digital course content is color adjusted (104) by a skilled colorist. The Film Master 106 (referred to herein as color space X) requires scene by scene adjustment to prepare the content for film projection. The Digital Cinema Master 108 (Referred to herein as color space Y) requires scene-by-scene adjustments made for digital cinema, and the video master (herein referred to as color space Z) requires a scene-by-scene adjustment made for the home vide environment.

[0008] Due to the significant differences between the characteristics of each variation, these color adjustments are very much a creative process and have not been easily automated. To date there exist no widely available mathematical transform that can translate from one of these versions to another. Thus, as these new display types and technologies are added that diverge significantly from those shown in the figure, it becomes necessary to generate additional variant masters to address these new display capabilities.

SUMMARY OF THE INVENTION

[0009] It is therefore an aspect of the present principles to provide a system for mastering and distributing enhanced color space video for utilizing the potential of new resolution display screens.

[0010] It is a further aspect of the present principles to provide a system and method that is designed to bring the original creative intent of the content creators to the viewer.

[0011] It is also another aspect of the present principles to defines a system for creating content that fully utilizes the potential of each new display type, while also addressing the need for efficient production of the increased number of variations

[0012] These and other aspects are achieved in accordance with present principles, wherein the method for modifying content to obtain enhanced color rendition for a target color space of a target display device includes the step of mastering the content in accordance with instructions from at least one content creator. The mastering includes adjusting the color rendition within the content for each target color space with respect to a reference color space. The master content is encoded in accordance with the target color space specific adjusted color rendition information to enable display of the content with the enhanced color rendition on the target display device.

[0013] According to one aspect, the adjusting includes storing each target color space specific adjustment as metadata.

[0014] The encoding includes creating an enhanced color channel by identifying base band reference content, compressing the base band reference video content, and determining a color difference between the un-compressed base band reference video content and the com-

pressed base band content.

[0015] Once encoded, the content is transmitted over the enhanced color transmission channel. When received, the encoded content, having color information indicative of the adjusted color rendition and the color display properties of the target display device, are adjusted according to the decoded color rendition information. The result is displayed on the viewer's target display device.

[0016] The decoded content can include base band reference data and color adjustment data specific to the target color space and adapted to provide a true color reproduction in accordance with display capabilities of the target display device.

[0017] According to another aspect of the present principles, the mastering of content includes identifying auxiliary data relating to each target color space and storing the same. In other aspects of the present principles, the metadata can be combined with the auxiliary data before transmission. One of the metadata and/or the auxiliary data includes dynamic display information data relating to adjustments to be made to target display device settings. Examples of such display device settings include brightness, contrast and luminance.

[0018] According to yet a further aspect of the present principles, the method for modifying content to obtain enhanced color rendition for a non-standard system target color space of a target display device includes identifying adjustments required to be made to the content in order to reproduce the same on a non-standard system target color space. The adjustments are performed in accordance with instruction from at least one content creator. The identified adjustments for each target color space are stored in a memory, and base band/reference data is encoded along with the stored adjustment data in order to enable display of the content with the enhanced color rendition on a target display device corresponding to the target color space.

[0019] The encoding includes creating an enhanced color channel by compressing the base band reference content, and determining a color difference between the un-compressed base band/reference content and the compressed base band/reference content.

[0020] The system for modifying video to obtain enhanced color rendition for a target color space of a target display device includes means for adjusting the color rendition within the content in accordance with instruction from at least one content creator, and means for encoding the content having color information indicative of the adjusted color rendition to enable display of the content with the enhanced color rendition on the target display device.

[0021] The encoded video is transmitted over an enhanced color channel which comprises compressed base band/reference video content, and color difference information relating to a color difference between an un-compressed base band/reference content and the compressed base band/reference content.

[0022] Other objects and features of the present inven-

tion will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] In the drawings, like reference numerals denote similar components throughout the views.

Figure 1 is block diagram of the color space relationship in today's post-production processes;

Figure 2 is end to end block diagram of the method for mastering and distributing enhanced color space content to the consumer's home according to an embodiment of the present principles;

Figure 3 is a block diagram of the content mastering according to an embodiment of the present principles;

Figure 4 is a block diagram representing the content packaging/coding according to an embodiment of the present principles;

Figure 5 is a block diagram representing creation of an enhanced color channel as part of the content packaging aspect of the present principles;

Figure 6a is a block diagram of the decoding performed in the system and method for mastering and enhancing color space video according to an embodiment of the present principles;

Figure 6b is a block diagram of the decoding performed in the system and method for mastering and enhancing color space content according to another embodiment of the invention; and

Figures 7a and 7b are block diagrams of exemplary types of consumer connections for the implementation of the system and method of the present principles.

DETAILED DESCRIPTION

[0024] The presently described system and method for mastering and distributing enhanced color space content, such as video, is enabled because new display technologies becoming available that provide greater picture reproduction capabilities than the traditional displays, such as traditional CRT-based color television systems. The quality of picture reproduction increases, fewer sacrifices are required from the original intent of the content creator(s). However, with the increased number of new display technologies, each with different display characteristics, there is a need to create an increased number of content variations that address each display technol-

ogy's individual characteristics.

[0025] The "concept" referred to above can be described as providing the viewer with the capability to observe on a display device the content creator's artistic intent, with respect to color, and possibly other image characteristics, such as texture, intensity, noise etc. The system and method of the present invention could be referred to throughout this description as "Directors Vision", which as used herein, is synonymous with the same.

[0026] As the quality of picture reproduction increases, fewer sacrifices are required from the original intent of the content creator(s). However, with the increased number of new display technologies, each with different display characteristics, there is a need to create an increased number of variations of the content that address each display technology's individual characteristics. The present invention defines a system for creating and delivering content that fully utilizes the potential of each new display type, while also addressing the need for efficient production of these increased number of variations.

[0027] The following description refers to a "standard video system," which is defined herein to mean any existing video system or video signaling format whose color space is based on traditional CRT phosphor technologies, with standard or high definition (e.g. NTSC, PAL, SECAM, CCIR-601, ITU-R bt.709, etc.). As will become apparent, the technique of the present principles can be applied to other types of content delivery systems.

[0028] The following description also makes reference to a theoretical media source (e.g., a "player,") which can be interpreted to mean any DVD, HD Blu-Ray Disc, cable, satellite or other device, including personal computers and game consoles capable of providing content to a display device.

[0029] The Directors Vision system of the present invention provides a better picture for display devices that are capable of such display, such as HDR displays for example. One possible system for delivering this content could be:

Directors Vision authored- HD optical disc → Directors Vision-capable player → HDR television
Other delivery paths are possible and the actual decoder can exist in several places. In all cases, the content must be created with a known or reference color space.

[0030] It is to be understood that the technique of the present principles could be implemented in various forms of hardware, software, firmware, special purpose processors, or a combination thereof. Preferably, the present invention is implemented as a combination of hardware and software. Moreover, the software is preferably implemented as an application program tangibly embodied on a program storage device. The application program could be uploaded to, and executed by, a machine comprising any suitable architecture. Preferably, the machine

is implemented on a computer platform having hardware such as one or more central processing units (CPU), a random access memory (RAM), and input/output (I/O) interface(s). The computer platform also includes an operating system and microinstruction code. The various processes and functions described herein either could be part of the microinstruction code or part of the application program (or a combination thereof) that is executed via the operating system. In addition, various other peripheral devices could be connected to the computer platform such as an additional data storage device and a printing device.

[0031] It is to be further understood that, because some of the constituent system components and method steps depicted in the accompanying Figures are preferably implemented in software, the actual connections between the system components (or the process steps) could differ depending upon the manner in which the present invention is programmed. Given the teachings herein, one of ordinary skill in the related art will be able to contemplate these and similar implementations or configurations of the present invention.

[0032] The description of the present invention is broken into the following four (4) areas: 1) Content Creation; 2) Content Packaging; 3) Content Decoding; and 4) Content Display.

[0033] Figure 2 shows a high-level block diagram of the system 200 for the method and system for mastering and distributing enhanced color space content, according to an aspect of the invention. As shown, initially the content is mastered (202), and then packaged (204). The packaged content is transmitted through a channel (206), received by a decoder (208) where it is decoded for display (210) on the consumer's display device.

I. Content Creation/Mastering

[0034] Figure 3 shows a block representation of some of the primary steps performed during the Content Creation/Mastering step 202 of FIG. 2. A colorist starts with high resolution digital source content - DSC during step 302 and adjusts the color display during step 304, in conjunction with the content creator's intent, as viewed on a calibrated display device (for example, a digital projector calibrated to the P7V2 digital cinema color space). Because each type of display has significantly different display characteristics, it is essentially a creative process to create a different master for each. With the entrance of new display technologies into the marketplace that afford expanded visual capabilities, additional content variants must be created to fully utilize these technologies. The Directors Vision system as described herein defines a mechanism for creating each of these different masters in a non-destructive manner. This is done by starting with Digital Source Content (DSC) such as digital scans of film elements during step 302, thereafter performing the color adjustments for each individual master during step 304, and then storing those color adjustments as meta-

data for the digital scans (i.e. a "Color Decision List") during step 306. When one variant master will be similar to another, such as a digital cinema master similar to a film master, the similar master can be used as a basis for deriving the variant content. The metadata undergoes storage in a memory device 308 of any suitable known type (e.g., ROM, RAM, Optical media, Magnetic media, etc.).

[0035] By way of example, the mastering of content can include; 1) The original edited elements of a film being scanned digitally to serve as the Digital Source Content (DSC) during step 302 A series of adjustments are made to create the film master (for each type of target color space, i.e., each type of display device) and are stored as metadata (i.e. the color decision list) during steps 304 and 306 of FIG. 3) The film master's color decision list can then be used as a basis for deriving the digital cinema master (again, composed of the original digital source data plus the color decision list metadata); and 4) When it is later time to create the video master, which varies more widely from the other two, either one of the existing color decision lists (metadata) can be used as a reference, or it can be generated from scratch.

[0036] In accordance with other contemplated embodiments, the metadata can include other information for controlling the display of content in the target color space of the display device. By way of example, the metadata can control the contrast and/or brightness of the image, as well as other parameters such as texture, noise and/or intensity. During content creation, the content creator could thus define settings for the display device to follow, assuming the device has the ability to make use of such information. These settings could be based, for example, on environmental lighting conditions where the 'target' display device is located, and could be adjusted automatically as those conditions change over time (e.g. daytime versus nighttime viewing).

[0037] Another area where the metadata can be used is in dynamic range enhancement. Often, the full dynamic range of the output device is not used. In addition, new display devices with much wider dynamic range are emerging. As mentioned below, the auxiliary data can carry dynamic range information instead of or in addition to the metadata, depending on the particular implementation of the Directors Vision system of the present principles.

II. Content Packaging

[0038] Content packaging comprises the encoding the content such that it can be distributed on packaged media (or delivered via a channel with finite bandwidth) and played on both standard and enhanced video systems. In addition, the content packaging includes the creation of an enhanced color channel. Figures 4-5 show block diagrams representing the content packaging 204 according to an embodiment of the present principles.

[0039] There are described two possible methods for

encoding (i.e., packaging) the content. Those of ordinary skill in the art will recognize that some methods could be more practical than others depending on storage media or other variable factors, but could be used without departing from the spirit of the present invention.

[0040] The two proposed methods are:

A. A special Directors Vision encoding format containing the original uncompressed or losslessly compressed digital source content (DSC) with additional metadata describing how to manipulate the original content to be best represented on each type of video system. The potential downside of this is that the data size on the media could be very large and a complex color processing is needed for each system. This encoding technique could prove to be most useful during the content creation stage; and

B. Extended color representation metadata sent as an auxiliary stream along with the base-band content that can be displayed correctly on a standard video system. The metadata would describe how to manipulate the base-band content to "step up" to an enhanced target display.

[0041] Referring to Figures 4-5, with either approach, in order to properly encode the colorspace data, it is first necessary to establish the color primaries (402) that are used to encode the content. This information can be represented most simply by using CIE color space coordinates. When the original mastering of the content is done, a suitably calibrated display must be used. The value of the color primaries and the maximum brightness value must be known or measured (402). It is also important that the reference display has linear color tracking within a few milli-CIE, and that the reference 'zero' luminance value is known (404). With this information, a precise, portable reproduction of the original color is possible. Once this information is obtained, the content (base band) data 410, auxiliary data and/or metadata 412 are encoded for transmission over the channel. Those of skill in the art recognize that the reference display is a fundamental working element of any portable standard.

[0042] In order to encode the data according to the present invention, it is necessary to determine the relationship between the reference color space and each 'target' color space (step 406). In general, the 'target' color space will be smaller than the reference color space. The 'target' color space will depend on the expected display medium (film, CRT, or some other display). In today's context, the 'target' display would be a CRT, as this is the current industry standard. Colors that fall outside of the target device's gamut would be encoded as an 'auxiliary' data stream.

[0043] Those of skill in the art will recognize that there are many different algorithms that can be implemented in the converting of the reference color space to the target color space. Some which could be proprietary, others of

which could be readily available to the public. By way of example, the colors from the reference space that are outside the 'target' might simply be set to the nearest color that falls on the boundary of the 'target' color space.

[0044] Figure 4 shows that the encoded output includes the base band data 410, the stored metadata 412 relating to each display type, and/or auxiliary data 414. In other contemplated aspects of the present principles, the metadata 412 can be included as part of the auxiliary data 414 to minimize the size and/or bandwidth required to transmit the content over the transmission channel.

[0045] One advantage to the method of the present principles is that the size of the auxiliary data (and/or metadata) is determined by the difference between the reference color space and the 'target' display or color space. In some cases, this difference could be zero, but it can be as large as needed to represent the original digital source content. It should be noted, however, that this principle can apply to a reference display, which has more than 3 color primaries, in fact, any number of color primaries is allowed.

Method A

[0046] According to one possible embodiment, the first method defined above for storing the color information begins by storing the entire original digital source content (perhaps with lossless or even lossy compression) along with additional metadata for each type of supported display type. For example, when addressing both a standard video system (e.g. NTSC) and one enhanced video system (e.g. a type High Dynamic Range display), the original digital source content would be stored along with the standard video system color metadata and the enhanced video system metadata (i.e. DSC + NTSC metadata + HDR metadata). In this way, a wide array of display types can be supported by simply adding additional metadata to the package. (It is assumed that the metadata will generally be much more compact than the digital source content, itself.) However, one significant drawback to this approach is that it is generally incompatible with existing video formats that are not Directors Vision capable.

Method B

[0047] The second method defined above addresses the compatibility issue by starting with base-band encoded digital source content that is compatible with standard video systems. To create this content, the original digital source content must be processed according to the adjustments necessary for the standard video format. The resulting modified source content would then form the basis of what is stored (with or without compression) in the package. When played back directly, without modification, the content would play properly on a standard video system. In order to support an enhanced video system, additional metadata would be included to describe how to "step up" to the enhanced system. This metadata

would be derived by considering the color space difference between the enhanced video system's "target" device and the standard video system's device. These difference values would provide the information necessary to convert the standard video system content into content that is suitable for the enhanced video system. Taking the example given above, the package would contain the NTSC content and metadata for the converting this to the enhanced video system (i.e. NTSC Content + NTSC-to-HDR metadata). This would allow the existing content to play properly to the standard video system (remaining compatible with existing package media formats), while also providing a mechanism for a special Directors Vision-capable player to use the extra metadata to support the enhanced video system, as well.

[0048] Figures 5 shows a block diagram representation of the creation of the enhanced color space according to part of the encoding and decoding aspects of the present invention. The mastered content 502 (color space A) is created as described above. This mastered content 502 includes the metadata for display types as described above. A compressed version of the master is the created. Thus, the color space A undergoes both a transformation and compression and is represented by the content compression (Color Space B) 504. By compressing the master content, there results a color difference 506. This color difference 506 can be compressed (508) if desired. The color difference 506 plus the color space B can be used to recreate the new color space C more accurately.

III. Content Decoding

[0049] As will be understood, the content decoding can take several forms, and ultimately is dependent on the encoding technique used to package the content for channel transmission.

[0050] Figures 6a and 6b show the decoding side of the received transmission, where the decoded color difference and the decoded master content (with metadata) are combined to recreate the color expansion, or color space C of the Target Color Space (i.e., consumer display device). Color space C is designated or targeted toward a specific class of display devices (e.g., plasma, LCD, DLP, etc.). It will be apparent to those of skill in the art that the color space C is a much closer approximation of Color Space A than a simple decompression of the compressed Color Space B would be.

[0051] Figure 6a shows one embodiment of the decoding 600 according the present invention. As shown and will be described, the decoded content 606 is re-combined with the decoded color difference 604 for the target color space, to reproduce the color space C corresponding to the same. The display specific metadata contained within the decoded content is also used during the decoding in order to format the new color space C for the particular consumers display device (i.e., target color space). Depending on the type of display device and oth-

er data relating to dynamic range, etc., the auxiliary data 606 could or could not be used during decoding.

[0052] The following are some proposed exemplary methods for decoding according the present invention:

- (a) A special Directors Vision -capable player that performs all color determination. In this format, the player will perform all of the decoding and color determination. The player has the capability of providing both standard and enhanced video output; or
- (b) A special player that passes Directors Vision information to a special Directors Vision-capable display. In this format, the player performs decoding but passes the color information (including both encoded video and additional color metadata and/or auxiliary data) to the display device for processing. (Note, the metadata could be transferred via an alternate path or connection to the display device, such as via an Ethernet port.) When connected to a non-capable (i.e. standard video system) display device, only the base-band content color information appropriate for that device is delivered. In both proposed methodologies, a key goal is to maintain full support for both standard video systems and the new features of enhanced video systems at all times.

[0053] Once the content has been suitably mastered and encoded, the decoding is also straightforward. For a 'target' device whose color gamut matches the reference for the encoded content, the auxiliary data is ignored during decoding. However, for a 'target' device whose color gamut differs from the encoded content's source reference, it is necessary to decode the auxiliary data 608 and convert the result into a format that is accepted by the display (e.g. RGB or YUV). Depending on the native color representation of the display device, the display could require first decoding and applying the auxiliary data within a theoretical color model, and then converting the result to the display device's native color representation. This could be necessary, for example, if the display device's native color representation is unable to represent all of the original source color values. For instance, it could be desirable to perform all Directors Vision color coding and manipulation in the YUV color space, and then convert the final value to RGB for transmission to the display device.

IV. Content Display

[0054] The display of the content is the final step (210) of the method of the present principles. Figures 7a and 7b show two exemplary interconnections of two different display devices according to an aspect of the present principles. In the case of content display, it is again necessary for the display device and the decoder to be able to share information about the color capabilities that are available versus those of the reference space (e.g. differences in color primaries between the reference space

and the display space). From this information, an appropriate algorithm for interpreting the color information for the display device can be selected. This could be as simple as exchanging data between the decoder and the display so that appropriate color values can be interpolated. However, it could also involve a far more sophisticated process to ensure even better results. (Due to the complexities of the human psycho-visual system and non-linear variations in display color space, simple linear interpolation of color values could not always deliver a sufficient end-user experience.)

[0055] Figure 7a shows a system 700a where the Directors Vision Decoder 702 is connected to an enhanced color display 704, typically via a DVI connection 706. In addition, the display 704 can be in communication with the decoder 702 via DVI connection 706, or utilize a separate suitable communication connection 708.

[0056] In some cases, the reference color space and 'target' display device could have a different number of color primaries. For example, the reference color space could have 3 color primaries and a white level and black level defined, whereas the 'target' display could have 7 color primaries along with white and black levels. In such cases, a suitable transcoding process must be performed. In addition, the display device will also need to have a reasonable algorithm (with minimum error) for handling colors that fall outside its supported color space.

[0057] Output devices can perform the necessary calculations on the incoming video, but this could be computationally costly. An alternative approach could be utilized in which much of the computational burden is handled during the content creation and packaging stages and sent as data points to a Directors Vision-capable player or display. In this way, the metadata can be either for all of the picture or just parts of the picture, truly capturing the artist's intent in a manner that could not be possible using only the image processor at the end of the video pipeline. Figure 7b shows an embodiment of the invention where the display device handles the decoding aspect of the present invention. The connection 700b includes a Directors Vision Receiver 712 that does not contain a the Directors Vision decoder, but is connected to a Directors Vision capable display 714 via a digital link 716, such as, for example, an IEEE 1394 or other suitable digital communication medium.

[0058] While there have been shown, described and pointed out fundamental novel features of the invention as applied to preferred embodiments thereof, it will be understood that various omissions, substitutions and changes in the form and details of the methods described and devices illustrated, and in their operation, could be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements

and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention could be incorporated in any other disclosed, described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

Claims

1. A method for modifying standard system content that is compatible with a standard display device to obtain enhanced color rendition source content suitable for an enhanced display device, the method comprising the steps of:

obtaining metadata derived from color space difference between the enhanced display device and the standard display device, such difference providing information necessary to convert the standard system content into the enhanced color rendition source content, and converting the standard system content into the enhanced color rendition content according to the metadata.

2. Method according to claim 1 **characterized in that** the standard system content is obtained by processing an original digital source content according to color adjustments necessary for a standard video format of the standard display device.

3. Method according to any one of the preceding claims **characterized in that** it comprises the step of:

obtaining auxiliary data that represents colors outside of the enhanced display device's gamut.

4. Method according to any one of the preceding claims **characterized in that** it comprises, before the step of converting, the step of:

encoding the standard system content with the derived metadata and, if any, the auxiliary data, such that the packaged content can be distributed on a packaged media or delivered via a channel with finite bandwidth.

5. Method according to claim 4 **characterized in that** it comprises the step of:

transmitting the encoded content via a channel with finite bandwidth and optionally via an enhanced color channel.

6. Method according to claim 5 **characterized in that** it comprises the step of:

receiving the packaged content; and decoding the packaged content to obtain the decoded standard system content with the derived metadata and, if any, the auxiliary data.

7. Method according to claim 6 wherein the converting step comprises:

combining the decoded standard system content with the decoded color space difference resulting from the derived metadata to produce an enhanced color space of the enhanced display device; and providing the enhanced color rendition source content for display in the enhanced color space.

8. Method according to claim 7 further comprising:

converting the decoded auxiliary data into a format that is accepted by the enhanced display device.

9. Method according to claim 3 or 4 **characterized in that** it further comprises the steps of:

receiving and decoding transmitted content including the standard system content, the derived metadata and the auxiliary data; wherein the converting step comprises:

converting the decoded auxiliary data into a format compatible with the enhanced display device; and combining the decoded standard system content with the converted auxiliary data and the decoded color space difference resulting from the metadata to produce an enhanced color space of the enhanced display device; and

providing the enhanced color rendition source content for display by the enhanced display device in the enhanced color space.

10. Method according to claim 9 encoding the standard system content with the derived metadata and the auxiliary data, such that the packaged content can be distributed on a packaged media or delivered via a channel with finite bandwidth, transmitting the encoded content via a channel with finite bandwidth and optionally via an enhanced color channel.

11. A system for modifying standard system content that is compatible with a standard display device to obtain enhanced color rendition source content suitable for an enhanced display device, the system comprising:

a receiver for receiving the standard system content and metadata, wherein the metadata is derived from color space difference between the enhanced display device and the standard display device; 5
a decoder for decoding the standard system content and metadata to obtain decoded standard system content and color space difference; means for combining the decoded standard system content and color space difference to produce content in an enhanced color space for use with the enhanced display device; and 10
means for providing the enhanced color rendition content for display in the enhanced color space. 15

12. The system of claim 11, further comprising:

means for receiving and decoding auxiliary data representing colors that are outside of the enhanced display device's gamut; 20
means for converting the decoded auxiliary data into a format compatible with the enhanced display device; and
means for combining the converted auxiliary data with the decoded standard system content and color space difference for producing content in the enhanced color space. 25

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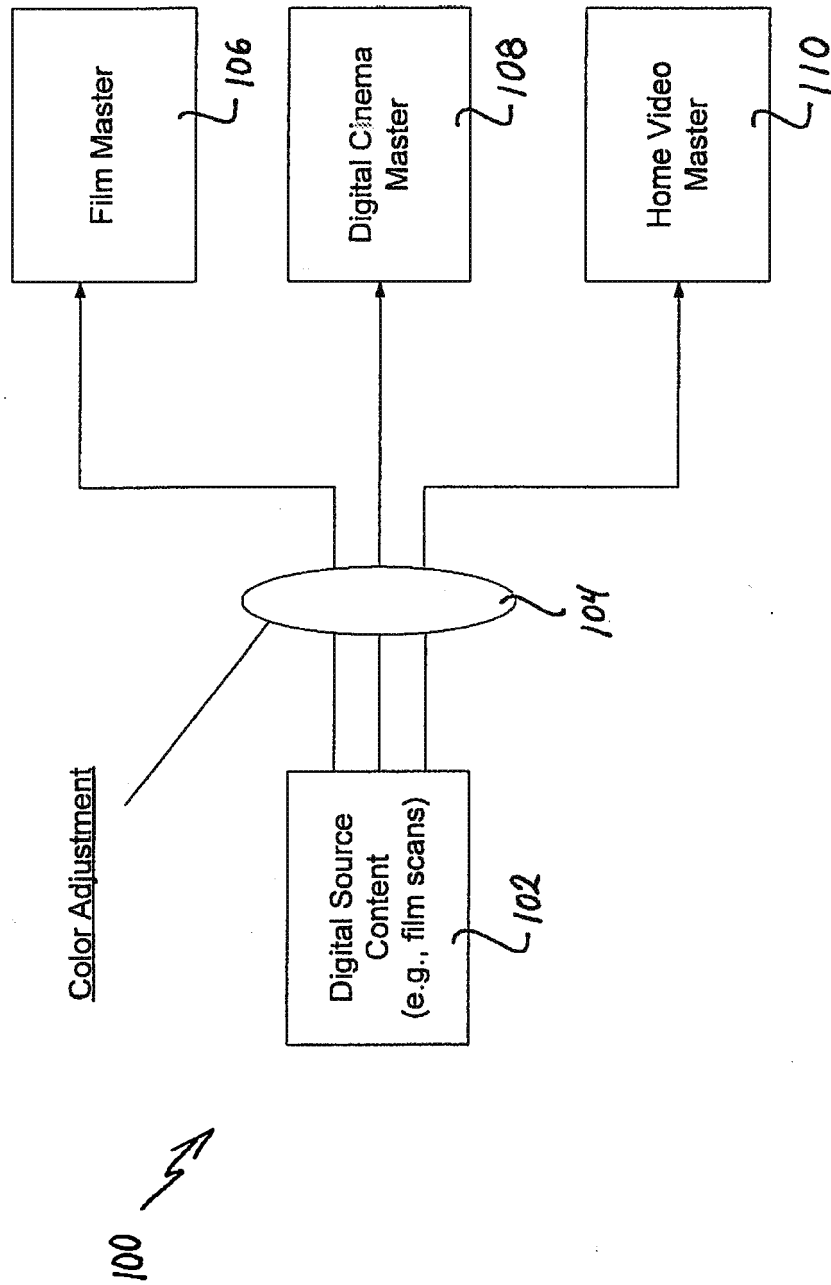


FIG. 1
(Prior Art)

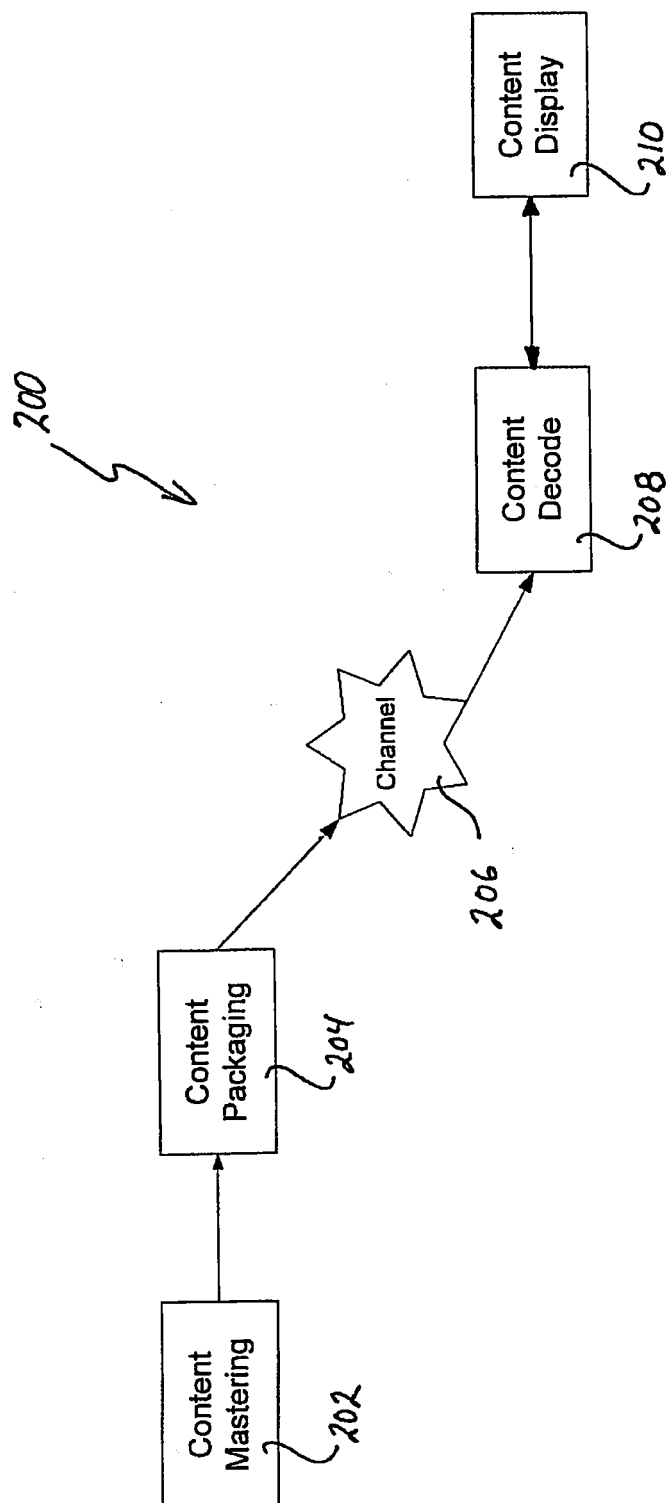


FIG. 2

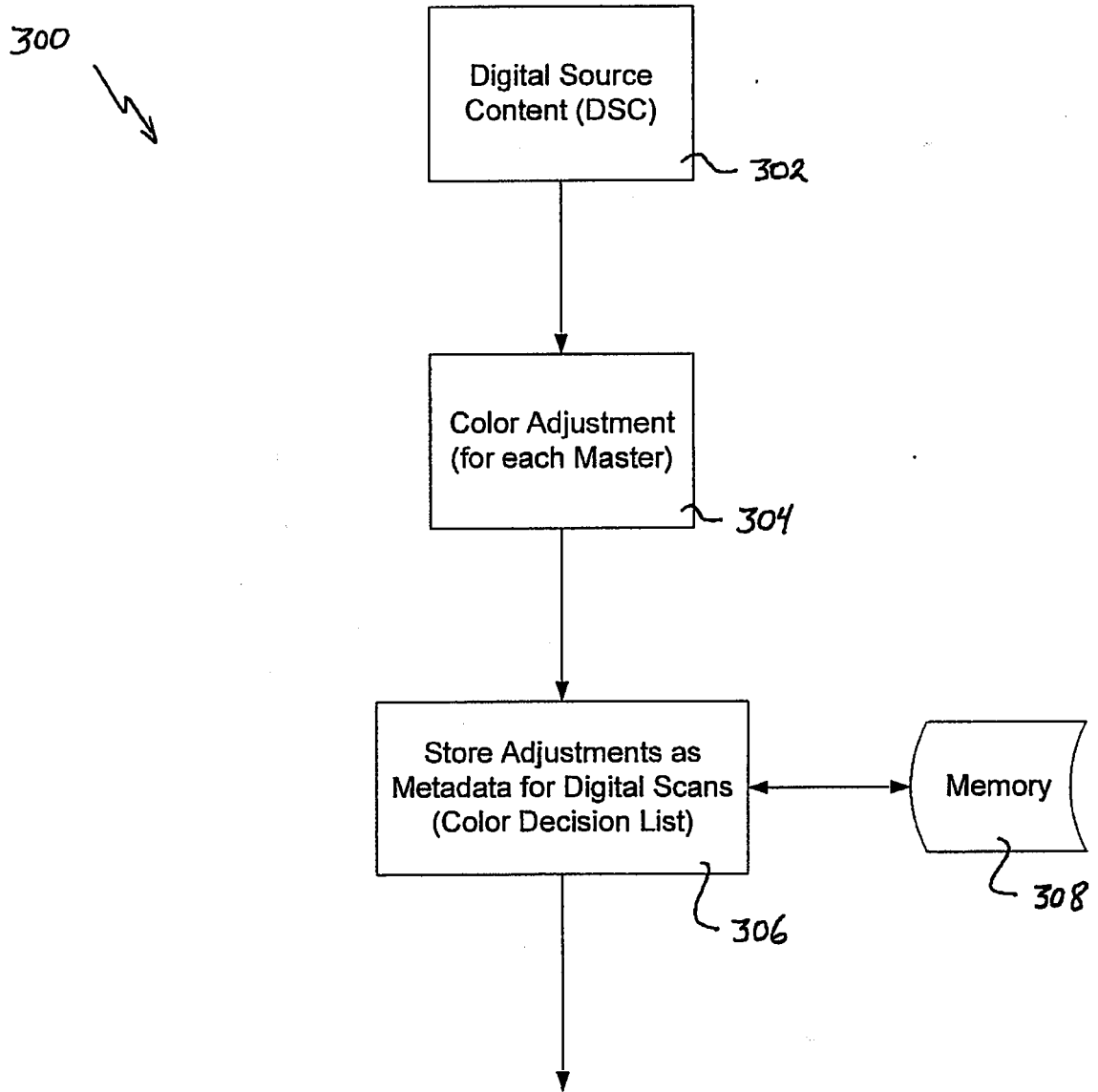


FIG. 3

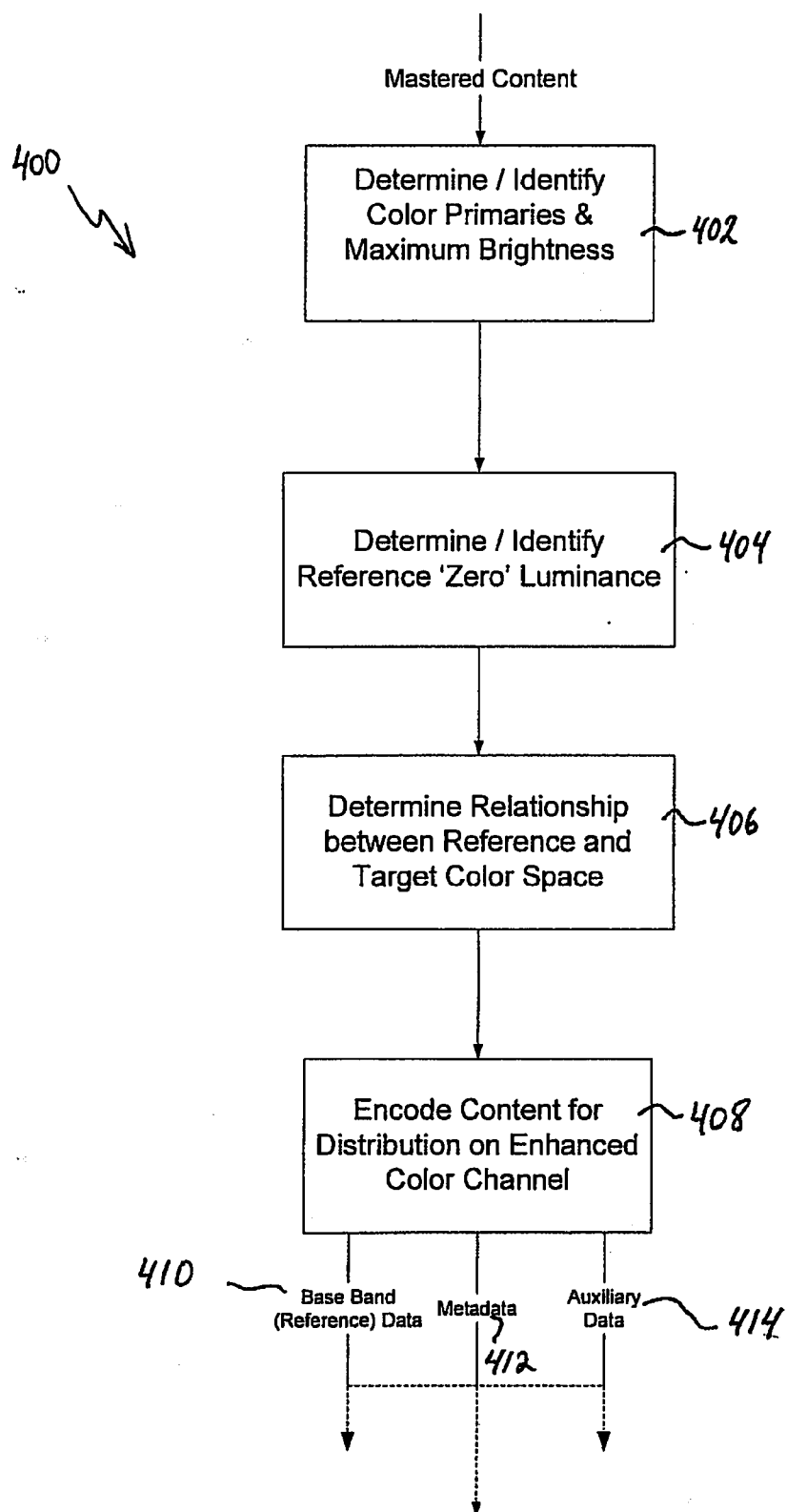


FIG. 4

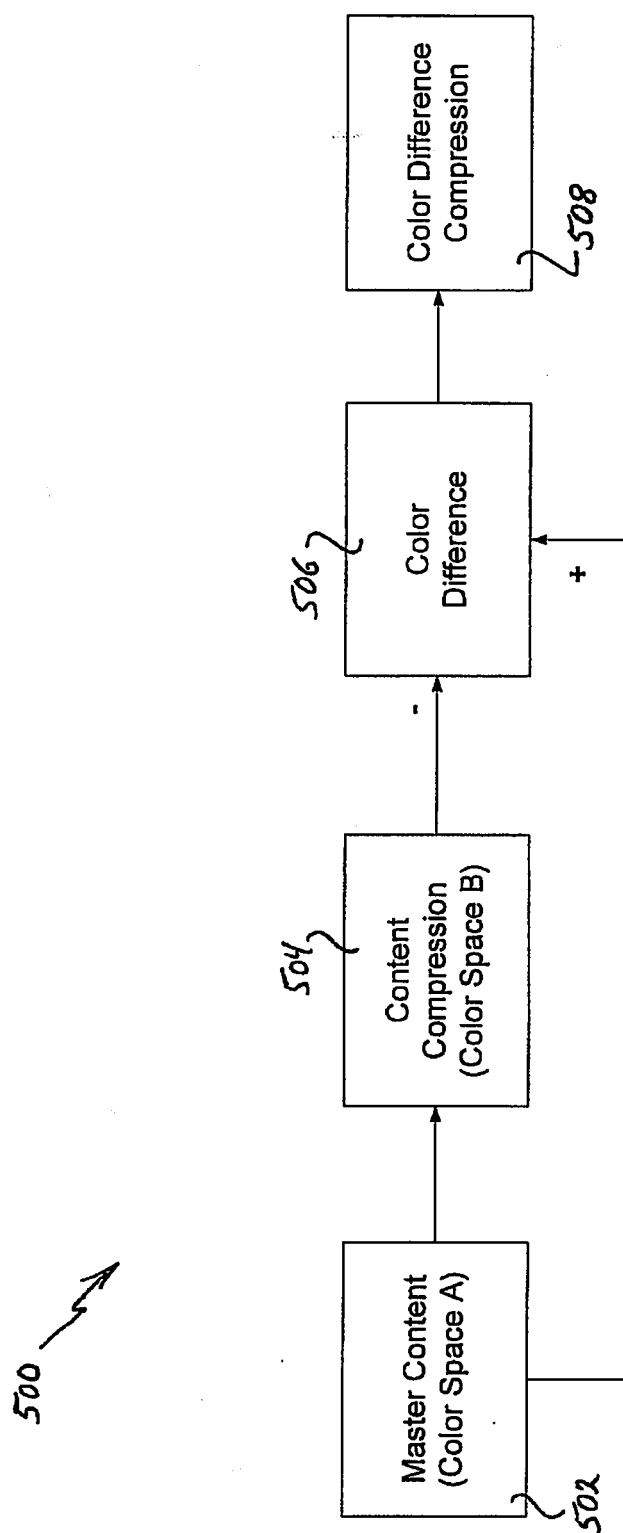


FIG. 5

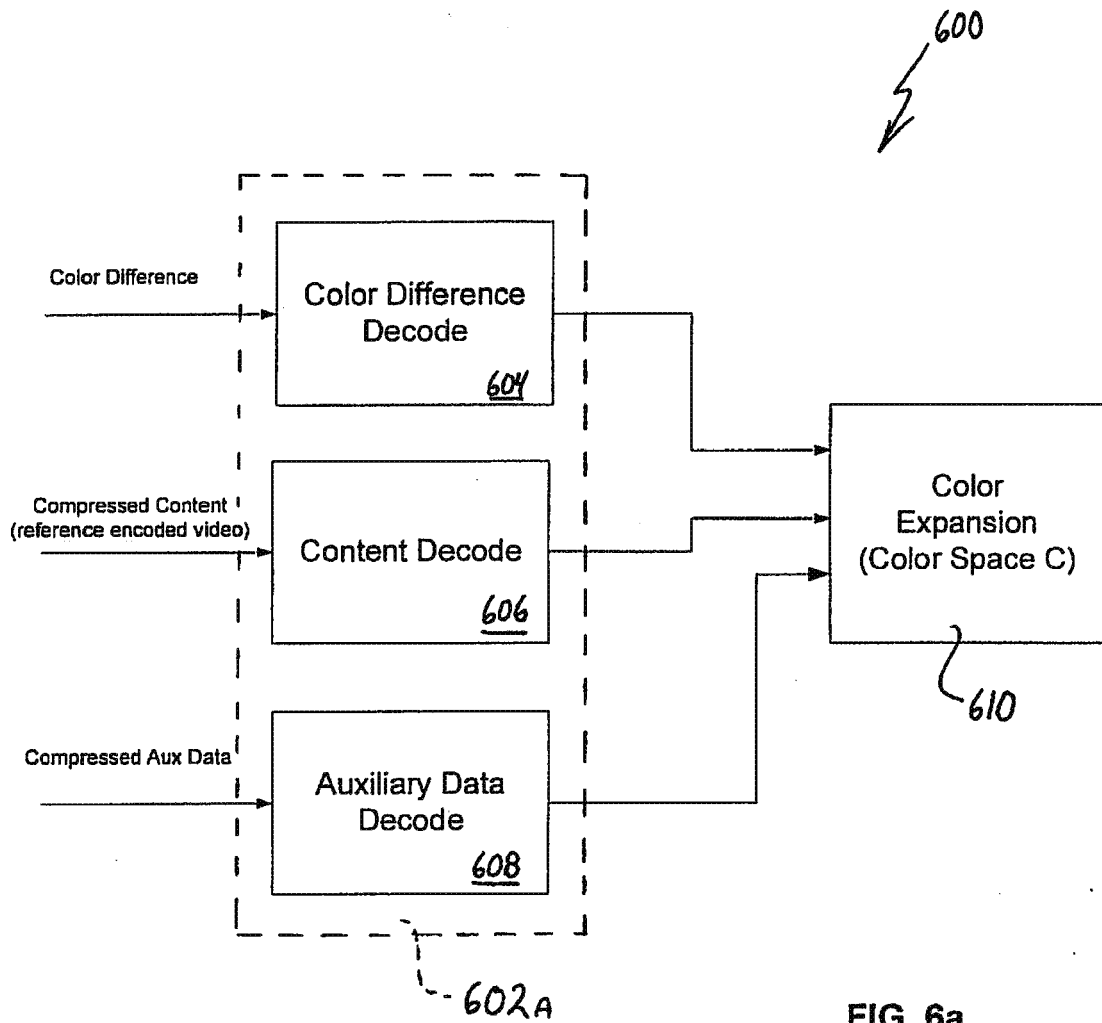


FIG. 6a

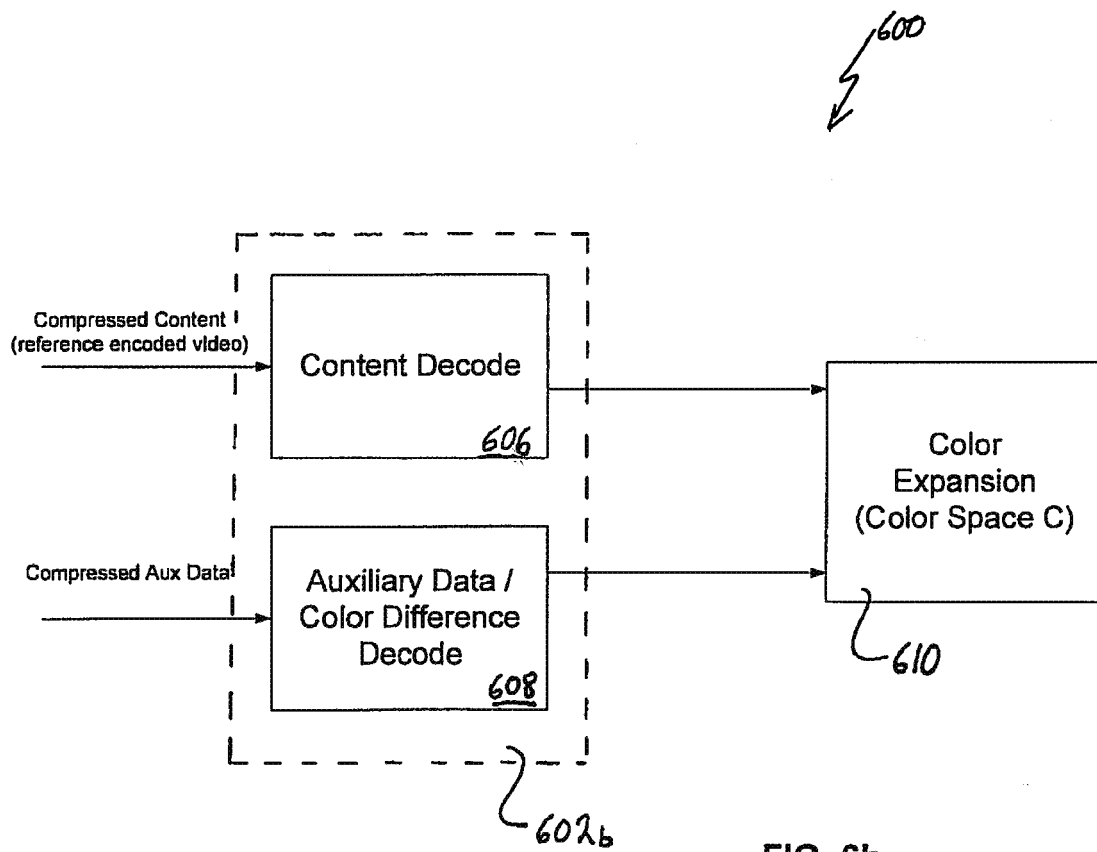


FIG. 6b

FIG. 7a

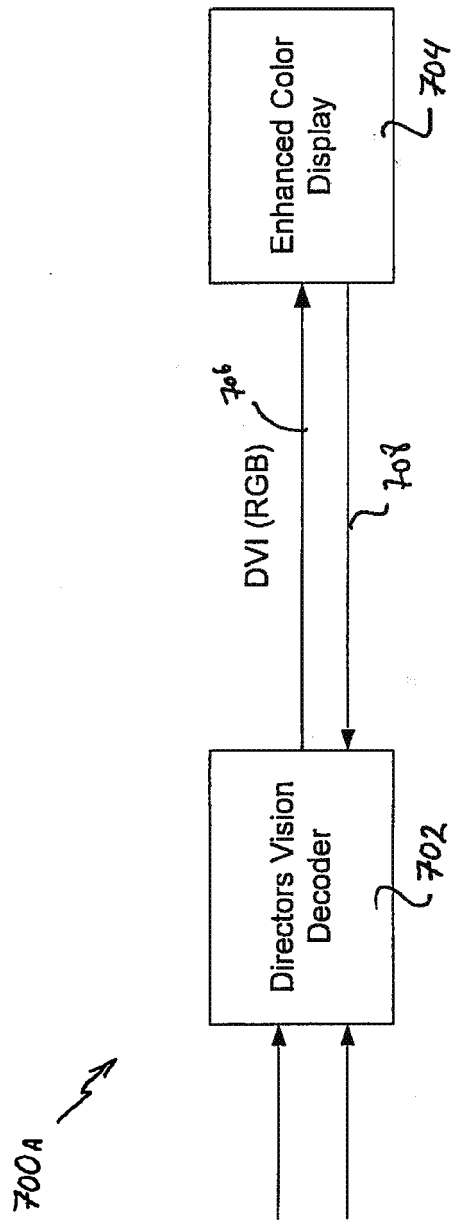
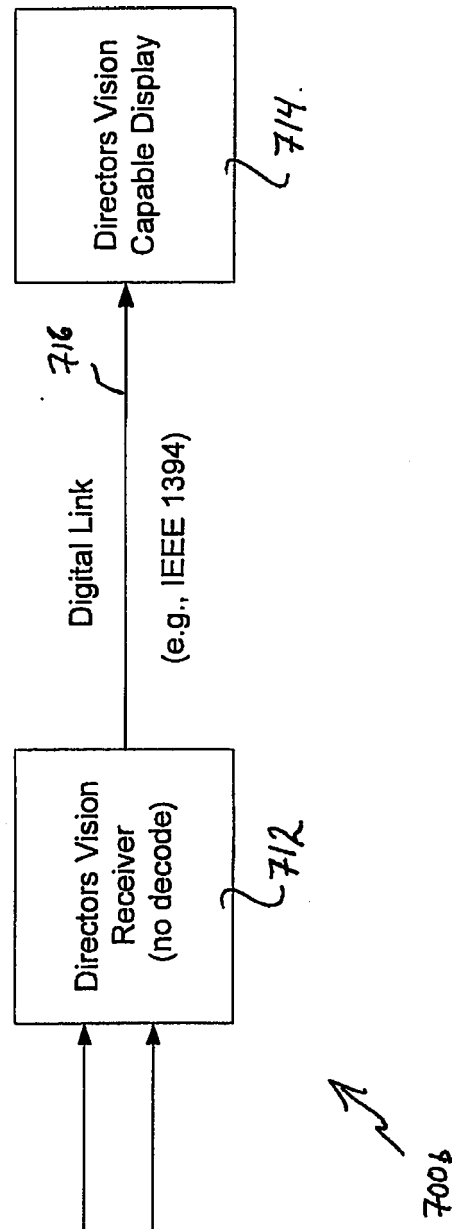


FIG. 7b



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 62388204 P [0001]